



Xcore MicroIIIS Series
384×288/640×512
Uncooled Thermal Imaging Module
User Manual
V1.0.3

IRay Technology Co., Ltd.

www.infiray.com

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This manual is used as a guide. The photos, graphics, diagrams and illustrations provided in the manual are only used to explain, which may be different from the specific product. Please refer to the real object. We try our best to make sure the contents in this manual are accurate. We do not provide any representations or warranties in this manual.

If you need the latest version of this manual, please contact us. It is recommended that you use this manual with the guidance of professionals.

Revision History

Version	Date	Comments	Remark	Revised by	Checked by
V1.0.0	2022-08	Initial Version			
V1.0.1	2022-10	1. Update CLK frequency 2. Update lens models			
V1.0.2	2022-11	1. Update product model			
V1.0.3	2022-01	1. Update lens parameters			

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1. Product Overviews

Xcore MicroIIIS Series thermal imaging module is specially designed for the applications that are sensitive to size, weight and power consumption. It is small in size, light in weight and low in power consumption. It supports a variety of serial communication interface, video output interface and lightweight infrared lens. It is suitable for miniaturized handheld devices, enhanced night vision goggles (ENVG), UAVs and multi-spectral systems, which supports thorough thermal image solution. The temperature measuring products can be used in industry measurement, power station measurement, security&surveillance measurement, and machine vision etc.

2. Product Models



M3S	011	01312X	00	N	Q	X
Models	Expansion board	Lens	Application Type	Startup Screen	Analog video	
M3S3: MicroIIIS 384 M3S6: M3S6: MicroIIIS 640	000: w/o 011:MRIII00V110F016C 012:MRIII00V100F012C 013:MRIII00V100F011C 014:MRIII00V100F008C 015:MRIII00V110F017C	00000X: no lens, flange dia.Φ22mm 00001X: no lens flange dia.Φ27mm 4D112X:4.1mm (only available for MicroIIIS 640) 4D410X:4.4mm (only available for MicroIIIS 384) 6D910X:6.9mm 9D110X:9.1mm	00: observation type 01: industrial temperature measurement(T series) 02:high- accuracy temperature	Y: Yes N: No (Analog video only)	Q: w/o P: PAL	

		01312X: 13mm 01910X: 19mm 02510X: 25mm 03510X: 35mm 05510X: 55mm (T, TH series is not supported) 07510X: 75mm (T, T H series is not supported) 10010X: 100mm (T, TH series is not supported)	e measurem ent(TH series)		
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Figure 1 Product Models

3. Lens Parameters

Module	MicrolIIS384/640							
Resolution	384×288	640×512	384×288	640×512	384×288	640×512	384×288	640×512
Focus	4.4mm F1.0	4.1mm F1.2	6.9mm F1.0		9.1mm F1.0		13mm F1.2	
Focus Type	Athermalization		Athermalization		Athermalization		Athermalization	
FOV	61.2°×45.4°	100°×82°	38°×29°	63°×50°	28°×21°	48°×38°	20°×15°	33°×26°
IFOV	2.73mrad	2.93mrad	1.74mrad	1.74mrad	1.31mrad	1.31mrad	0.92mrad	0.92mrad
Module	MicrolIIS384/640							
Resolution	384×288	640×512	384×288	640×512	384×288	640×512	384×288	640×512
Focus	19mm F1.0		25mm F1.0		35mm F1.0		55mm F1.0	
Focus Type	Athermalization		Athermalization		Athermalization		Athermalization	
FOV	13°×10°	22°×18°	10°×7.9°	17°×14°	7.5°×5.6°	12.5 ° × 10°	4.8°×3.6°	8°×6.4°
IFOV	0.63mrad	0.63mrad	0.48mrad	0.48mrad	0.34mrad	0.34mrad	0.21mrad	0.21mrad
Module	MicrolIIS384/640							
Resolution	384×288		640×512		384×288		640×512	
Focus	75mm F1.0				100mm F1.0			
Focus Type	Athermalization		Athermalization		Athermalization		Athermalization	
FOV	3.5°×2.6°		5.9°×4.7°		2.6°×2°		4.4°×3.5°	
IFOV	0.16mrad		0.16mrad		0.12mrad		0.12mrad	

4. Product Specification

Module		MicrolIIS384	MicrolIIS384T MicrolIIS384TH	MicrolIIS640	MicrolIIS640T MicrolIIS640TH
Detector Type		VOx Uncooled Infrared FPA			
Resolution		384×288		640×512	
Pixel Pitch		12μm			
Frame Rate		50Hz ⁽¹⁾			
Response Spectra		8～14μm			
NETD		≤50mK@25℃, F#1.0（≤40mK optional）			
TEC		No			
Image					
Brightness & Contrast Adjustment		Manual/Auto0/Auto1			
Polarity		Blackhot / whitehot			
Palette		Support ⁽²⁾			
Reticle		Display/disappear/move ⁽²⁾			
Digital Zoom		1.0~4.0×continuous zoom（step 0.1） ⁽²⁾			
Image Processing		Shutter-less ⁽⁸⁾			
		NUC			
		Digital filtering/noise reduction			
		DDE			
Image flip		Right-left/Up-down/Diagonal			
Power Supply					
Supply Voltage		4～5.5VDC ⁽³⁾			
		Expansion boards support 3.5～18VDC ⁽³⁾			
Typical Supply Voltage		4VDC ⁽³⁾			
Power Protection		Over-voltage/Under-voltage/Reverse Connection			
Typical Consumption @25℃	Excluding expansion board	<0.6W		<0.7W	
	Including expansion board	<0.8W		<0.9W	
Interface					

Video Output	Analog video	1 channel PAL ⁽⁴⁾
	Digital video	BT.656/ BT.1120
		14Bit or 8Bit LVCMOS ⁽⁵⁾
		LVDS
Serial Communication Interface		RS-232
		UART（3.3V）
Temperature Measurement Function ⁽⁶⁾		
Measuring Range		T series: -20℃～+150℃, +100℃～+550℃ TH series: 0~60℃
Measuring Accuracy ⁽⁷⁾		T series: ±3℃ or ±3% of reading（The larger value shall prevail）@ ambient temperature of -20℃~60℃ TH series: ±0.5℃@ target temperature 33℃~42℃;±1.0℃@ target temperature 20℃~33℃;±1.0℃@ target temperature 42℃~50℃
Measuring Tools		Spot, line, Area
Physical Property		
Weight (without lens and expansion board)		20g±3g
Size (without lens)		26mm × 26mm
Environmental adaptation		
Operating Temperature		T series: -40℃～+80℃(Measuring temp. at -20℃～+60℃) TH series: -10℃～+50℃（16℃~32℃ for accurate temperature measurement） Observation Type: -40℃ ~ +80℃
Storage Temperature		-45℃～+85℃
Humidity		5~95%, non-condensing
Vibration		6.06g, Random vibration, all axial direction
Shock		80g, 4ms, Final peak sawtooth wave, 3 axial 6 direction

Table 2 Product Specification

Note:

(1) The detector frequency is 50Hz, the video frequency is 50Hz for observation type, 25Hz for temperature measurement type.

(2) Color Palettes are only available in BT.656/ BT.1120 digital video, the digital zoom and cross cursor are only available in BT.656 digital video;

(3) All these power supply voltage values represent the voltage on module connector.

- (4) PAL analog video output format is PAL-D.
- (5) 14Bit or 8Bit LVCMOS digital video is only supported in Hirose 70-pin connector.
- (6) This function is only supported for temperature measurement products;
- (7) TH series requires the shell to meet the overall thermal conductivity of the shell heat flux $\geq 800\text{mW}$, Average heat of thermal conductors $\geq 90\text{J}/^{\circ}\text{C}$.
- (8) Only available for temperature measurement product, and there are some requirements for use conditions.

5. User Interface Description

The Hirose 70PIN connector named DF40C-70DP-0.4V(51) is used on the imaging module of power supply interfaces, RS-232 interfaces, UART interfaces, analog video interfaces, BT.656 digital video interfaces, 14Bit or 8Bit LVCMOS digital video interfaces and 4 keys interfaces are contained on the connector. Users can adopt the Hirose 70Pin DF40HC(3.0)-70DS-0.4V(51) to implement the connection between imaging module and user expansion components.

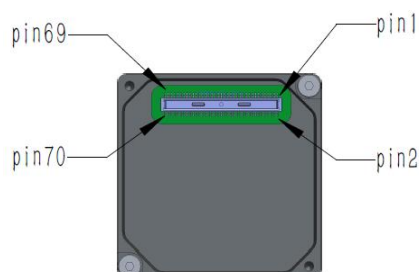


Figure 2 Hirose User Interface

5.1 Hirose 70pin Connector Definition

Pin NO.	Name	Type	Description			
1, 2, 3, 4	Power Supply	Power	Power Input (4~5.5VDC) ⁽¹⁾			
12, 19~22, 42	—	—	Not available			
15	RS-232_RX	Input	RS-232 Serial communication interface ⁽²⁾			
16	RS-232_TX	Output				
9, 11	VGND	Power	Ground of analog video ⁽³⁾			
10	VIDEO	Output	Analog video			
25	DV1	Output	16Bit or 14Bit or 8Bit LVCMOS Digital	Data	BT.656 BT.1120 (3.3V)	Data
26	DV0			Data LSB		Data LSB(BT.656)
27	DV3			Data		Data
28	DV2			Data		Data
29	DV5			Data		Data

Pin NO.	Name	Type	Description			
30	DV4	Output	video(3.3V)	Data		Data
31	DV7			Data MSB(8bit)		Data MSB (BT.656)
32	DV6			Data		Data
33	DV9		16Bit or14Bit or 8Bit LVCMOS Digital video (3.3V)	Data		--
34	DV8			Data		--
35	DV11			Data		--
36	DV10			Data		--
37	DV13			Data MSB(14bit)		--
38	DV12			Data		--
24	DV14			Data		Data
23	DV15			Data MSB(16bit)		Data MSB(BT.1120)
39	Line_Valid			Line valid signal		Line valid signal
40	Frame_Valid			Frame valid signal		Frame valid signal
41	Clock			Clock signal		Clock signal
45	UART_TX	Input/ Output	UART communication interface (3.3V) ⁽²⁾			
46	UART_RX					
48		Reserve d				
50						
52						
54						
47	LVDS_CLK+	Output	LVDS_H (VCCIO=1.8V)	Clock signal		
49	LVDS_CLK-					
51	LVDS_DATA0+			Data		
53	LVDS_DATA0-					
57	LVDS_DATA1+			Data		

Pin NO.	Name	Type	Description
59	LVDS_DATA1-		Data
61	LVDS_DATA2+		
63	LVDS_DATA2-		
65	LVDS_DATA3+		
67	LVDS_DATA3-		
58	IO0	Input/ Output	Reserved
60	IO1		Reserved
62	IO2		Reserved
64	IO3		Reserved
66	IO4		Reserved
68	IO5		Reserved
5, 6, 7, 8, 13, 14, 17, 18, 43, 44, 55, 56, 69, 70	GND	Power	Ground of power supply ⁽³⁾

Table 3 Hirose 70 Pins Connector Definition





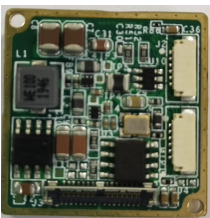
Note:


(1) Typical value of power supply is 4VDC, setup time (10% ~ 90%) < 4mS, peak current < 1.0A, ripple&noise < 40mVp-p.

(2) The TX and RX in serial communication interface represent the transfer and receive of this module.

(3) GND and VGND are shorted internally.

5.2 Expansion Board List

Model	Figure	IRay PN	Main Interface/Function	Connectors	Fit module
MRIII00V11 0F016C		2030101240	<ul style="list-style-type: none"> ● USB power supply, typical 5 V DC ● Communication: USB ● Video: USB UVC 	TYPE C	MicrolIS384, MicrolIS640
MRIII00V10 0F012C		2030100888	<ul style="list-style-type: none"> ● Power input 3.5~18 VDC, typical 12 VDC ● RS-232, Uart ● Analog video ● BT.656 digital video 	Hirose 20 pin DF52-20S-0.8H connector Molex 20 pin 52745-2097 connector	MicrolIS384, MicrolIS640
MRIII00V10 0F011C		2030100902	<ul style="list-style-type: none"> ● Power input: 3.5~18v, typical 12 VDC ● RS232, RS422 ● LVDS digital video ● Analog video 	DF56C-30S- 0.3V (51)	MicrolIS384, MicrolIS640
MRIII00V10 0F008C		2030101595	<ul style="list-style-type: none"> ● Power input: 3.5~18v, typical 12 VDC ● RS232, RS422 ● Cameralink digital video ● Analog video 	DF56C-30S- 0.3V (51)	MicrolIS384, MicrolIS640
MRIII00V11 0F017C		2030101721	<ul style="list-style-type: none"> ● Power input: 3.5~18V, typical 12 VDC ● RS232, RS422 ● MIPI digital video ● Analog video 	DF56C-30S- 0.3V (51)	MicrolIS384, MicrolIS640

Model	Figure	IRay PN	Main Interface/Function	Connectors	Fit module
Please contact salesman to confirm model.		Specific model correspondence	<ul style="list-style-type: none"> Used for fine tuning of lens- focus 	None	MicroIIIS 384, MicroIIIS640

5.3 LVCMOS Digital Video

LVCMOS digital video includes 1 Clock signal (Clock), 1 Line_Valid signal and 1 valid frame signal (Frame_Valid), and 14 data signals (dv0-dv13). Pixel data bits are divided into 14-bit and 8-bit, when the user chooses other data type except DRC, the data is 14-bit, namely DV [13:0], where DV0 is LSB and DV13 is the MSB. When the user selects DRC data, the data is 8-bit, namely DV[7:0], where DV0 is LSB and DV7 is the MSB.

LVCMOS digital video can be turned on or off via control commands. While the LVCMOS digital video is turned on, you can choose to output ORG data, NUC data, DRC data, DNS data and TEMP data.

When DRC data is selected, the thermal camera module does not support the function of digital zoom and temperature display.

Product model	Clock frequency
M3S384 Observation Type	22.5MHz
M3S640 Observation Type	37.5MHz
M3S384 Measurement Type	11.25MHz
M3S640 Measurement Type	18.75MHz

Table 4 LVCOMS Clock Frequency

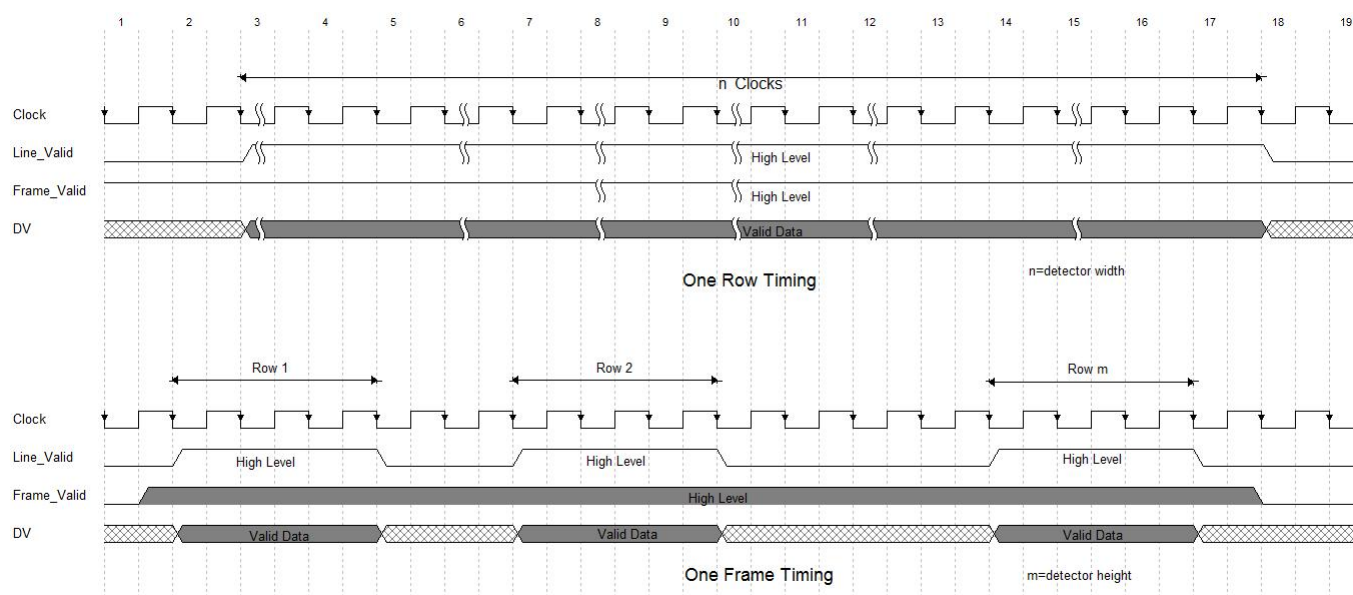


Figure 3 14bit or 8bit LVCMOS Digital Video Sequence Diagram

Note:

- (1) Clock rising edge sampling is recommended for DV.
- (2) Line_Valid and Frame_Valid are both high level valid.
- (3) after Line_Valid is valid, it lasts for n Clock, which corresponds to the data of the first column to the last column of the row in turn.

5.4 LVDS Digital Video

LVDS digital video includes 1 clock signal (LVDS_CLK) and 4 data signals (LVDS_DATA1, LVDS_DATA2, LVDS_DATA3 and LVDS_DATA4), can be easily analyzed by domestic mainstream video coding & decoding chip.

LVDS digital video can be turned on or off with control commands. The thermal camera module will output ORG data, NUC data, DRC data, DNS data and TEMP data when LVDS is enabled.

When DRC data is chosen, the thermal camera module does not support the function of electronic zoom and temperature display.

Product model	Clock frequency (LVDS_CLK)
M3S384 Observation Type	22.5MHz
M3S640 Observation Type	37.5MHz
M3S384 Measurement Type	11.25MHz
M3S640 Measurement Type	18.75MHz

Table 5 LVDS Clock Frequency

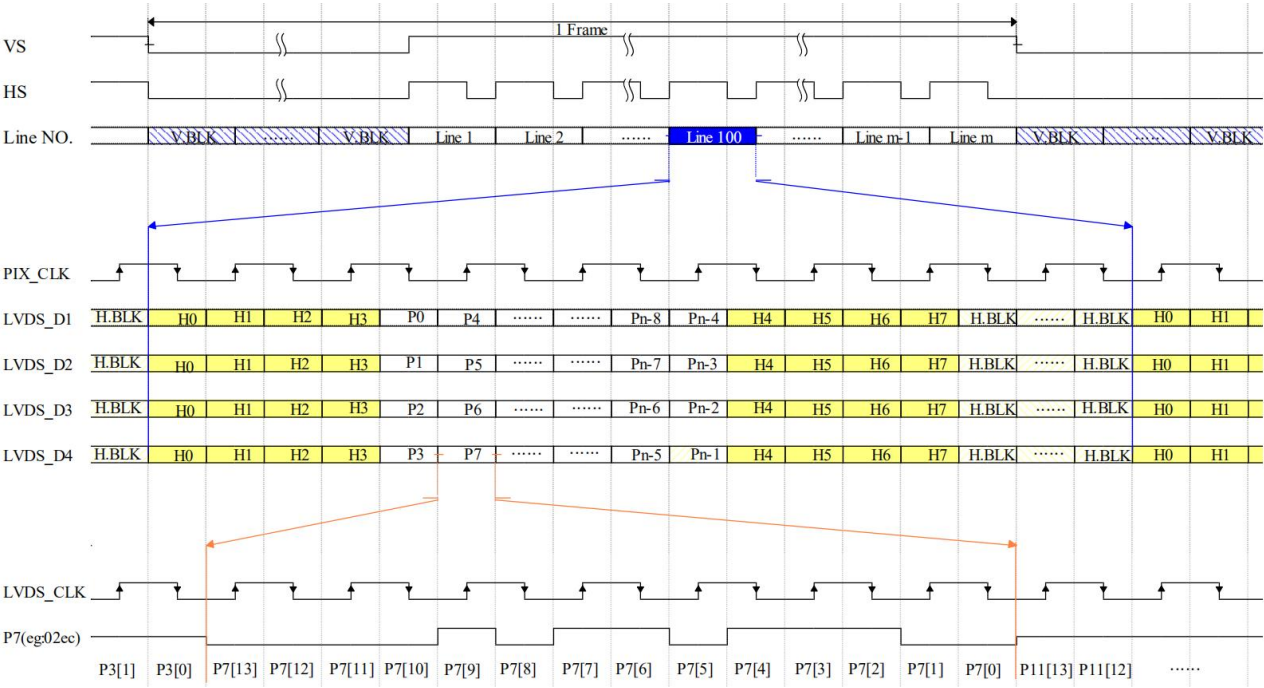


Figure 4 N×M Array of LVDS_H Digital Video Sequence Diagram

	H0	H1	H2	H3	H4	H5	H6	H7
BLANK LINE	3FFF	0000	0000	2AC0	3FFF	0000	0000	2D80
VALID LINE	3FFF	0000	0000	2000	3FFF	0000	0000	2740

Table 6

5.5 BT.1120 Digital Video

Bt.1120 digital video is the line by line output signal, including Clock signal (Clock), frame effective signal, line effective signal, 16 data signals (dv0-dv15). FIG. 5 sequence diagram takes $n \times m$ array as an example:

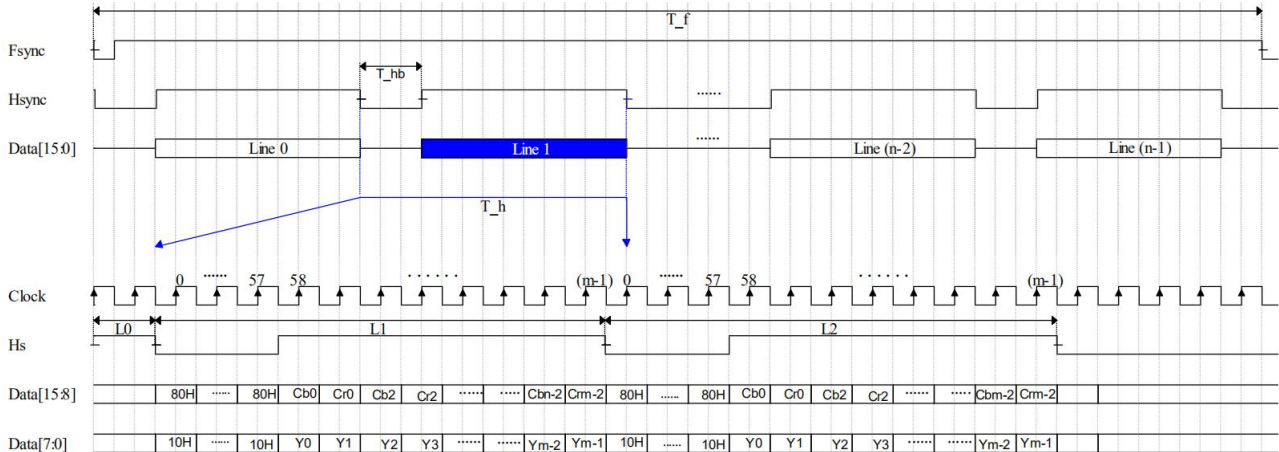


Figure 5 BT.1120 Digital Video Sequence Diagram

When BT.1120 digital video is selected, the thermal camera module does not support the function of electronic zoom, temperature display function.

Product model	Clock frequency
M3S384 Observation Type	22.5MHz
M3S640 Observation Type	37.5MHz
M3S384 Measurement Type	11.25MHz
M3S640 Measurement Type	18.75MHz

5.6 BT.656 Digital Video

Bt.656 digital video, including 1 Clock signal (Clock) and 8 data signals (DV0-DV7).

BT.656 digital video supports all functions of the thermal camera module (see table 1 for image adjustment and temperature measurement), including brightness/contrast adjustment, polarity selection, color Palette selection, reticle control, digital zoom and image flip functions, and only supports output image processing (DRC) data.

Product model	Clock frequency
M3S384 Observation Type	27MHz
M3S640 Observation Type	27MHz
M3S384 Measurement Type	27MHz
M3S640 Measurement Type	27MHz

5.7 CDS_2 Digital Video (only available for measurement type)

CDS_2 digital video contains 1 Clock signal (Clock), 1 frame valid signal (Vsync), 1 line valid signal (Hsync), and 16 DATA signals (DATA). The video data consists of two parts, the first half of each row of data is divided into an image, which conforms to the YUV422 format. The high 8 bits is the brightness component, the low 8 bits is the chroma component, and the image supports pseudo-color mapping. The second half of each row is divided into temperature data. The actual significant bit is 14 bits, and the higher two bits complement 0.

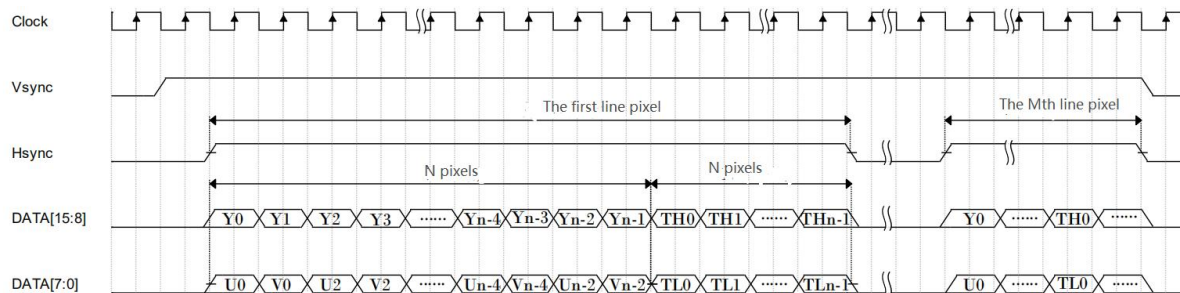


Figure 6 CDS_2 Digital Video Sequence Diagram

Note:

- (1) The output image data format is YUV, the high 8bit is Y, the low 8bit is UV.
- (2) "T" stands for temperature data (effective data bits are 14 bits lower, two bits higher complement 0), "TH" stands for 8 bits higher, and "TL" stands for 8 bits lower.
- (3) External synchronization signal mode is adopted. "Vsync" represents frame synchronization signal and "Hsync" represents row synchronization signal.
- (4) The output data of each row is 2 times of the array N, such as thermal camera module with array of 640*512, each row contains 640*2=1280 clock cycles (N = 640), and each frame contains 512 rows (M=512).

Product Model	CLK Frequency (Clock)
M3S384 Measurement Type	11.25MHz
M3S640 Measurement Type	18.75MHz

Table 7 CDS_2 CLK Frequency

5.8 MIPI Protocol

This thermal camera module uses 4-lane MIPI, MIPI interface includes 1 pair of source-synchronized differential clocks (MIPI_CLK+,MIPI_CLK-), and 4 pairs of differential data lines (MIPI_DATA0+,MIPI_DATA0-,MIPI_DATA1+,MIPI_DATA1-,MIPI_DATA2+, MIPI_DATA2-, MIPI_DATA3+, MIPI_DATA3-), the data format and electrical specifications conform to CSI-2 and D-PHY Protocols.

The clock signal enters the high-speed mode at the beginning of each frame, and exits it at the end of the frame. The inter-frame is in the low-power mode (the data and clock lines are both at 1.2V high level). The CLK frequency of MicroIII thermal camera module is 200MHz.

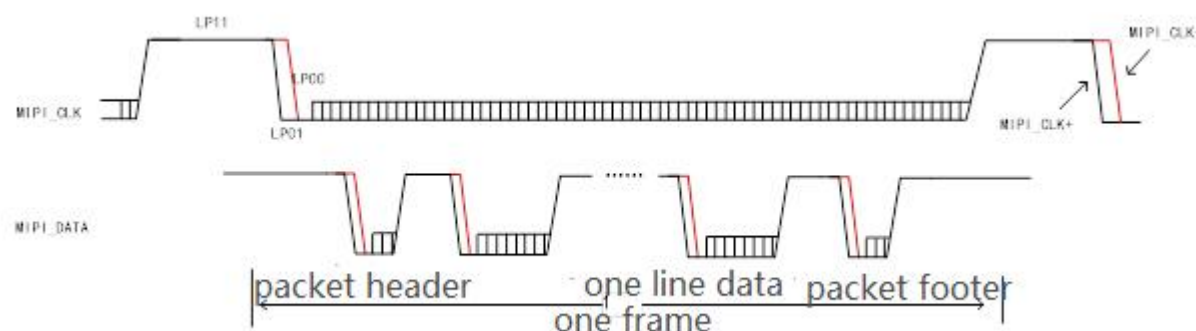


Figure 7 A Frame of Data

5.8.1 Imaging Modules

After the module is connected to power, it will start to output MIPI digital video. Take 640*512 array as an example, the output data format is as follows:

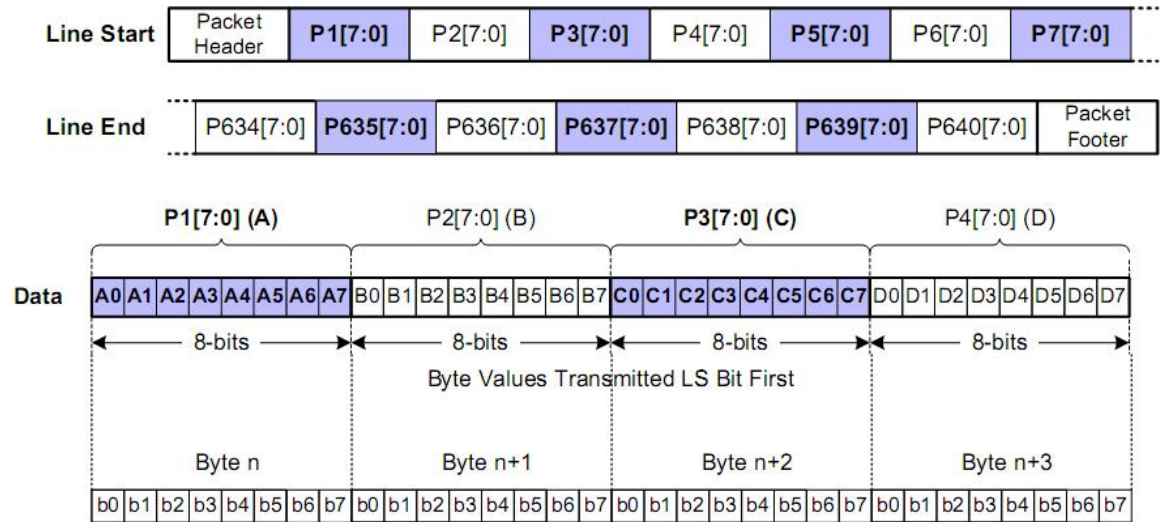
Data Format	Module Setting	Module Output
RAW8	LVC MOS +DRC	640*512*8bit
RAW8	NUC+LVCOMS LVC MOS+except DRC BT.1102	(640*2) *512*8bit (One pixel is made up of two bytes, low bit in

		front)
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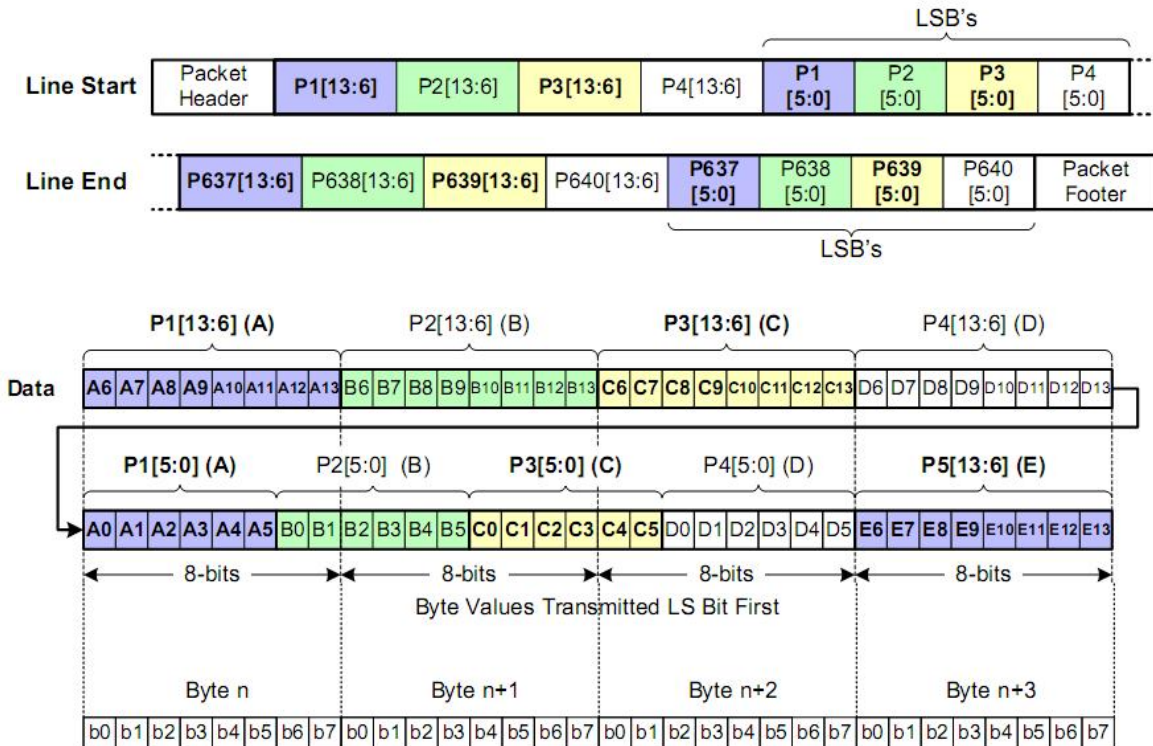
Table 7 Module Setting List

The data format is the standard MIPI CSI-2 protocol, as shown below.

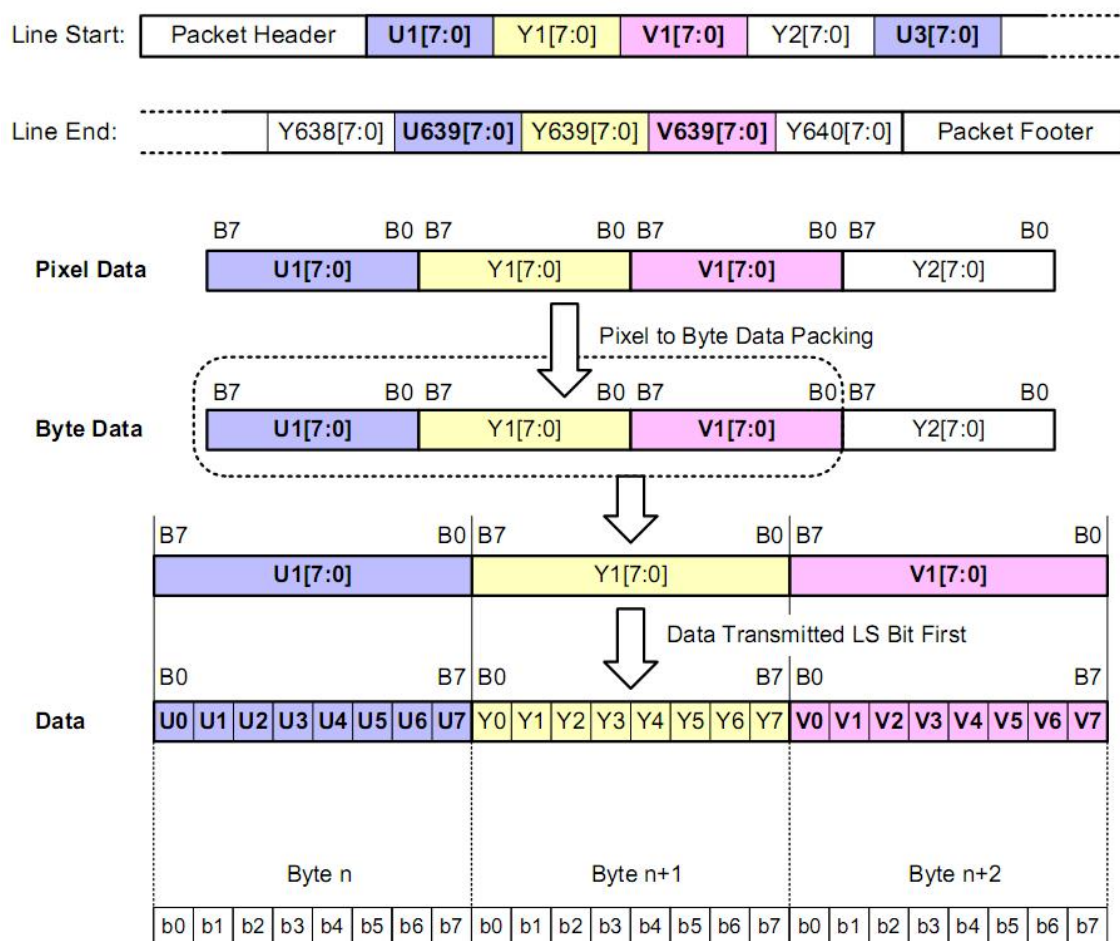
1) While DRC+LVCMOS is set, the Raw 8 data will be output (standard MIPI CSI-2 Protocols), the array should be set as 640*512 (refer to chapter 4 Hisilicon Platform Configuration Reference in *User Manual of MIPI expansion board* for detailed information), as shown in Figure 2.

**Figure 8 RAW8 Standard Protocol**

2)



3.YUV422



5.8.2 Thermographic Module

After the module is connected to power, it will start to output MIPI digital video and data of 1280*512 array. The data format can be set to YVU422 format through the refresh program. The module settings are as follows:

Data Format	Module Setting	Module Output
YUV422	CDS2	DRC with palette (left) +temperature(right)

Table 8 Module Setting List

The output of YUV422 is 1280*512 array data. The first 640 pixels of line valid data are image data, which can be output directly in YVU422 format. The last 640 pixels of line valid data are temperature data, which requires that the UYVY backend of 2 pixels is spliced into two 16-bit temperature data by itself, with the more significant byte first. The data format of one line is shown in the figure below.

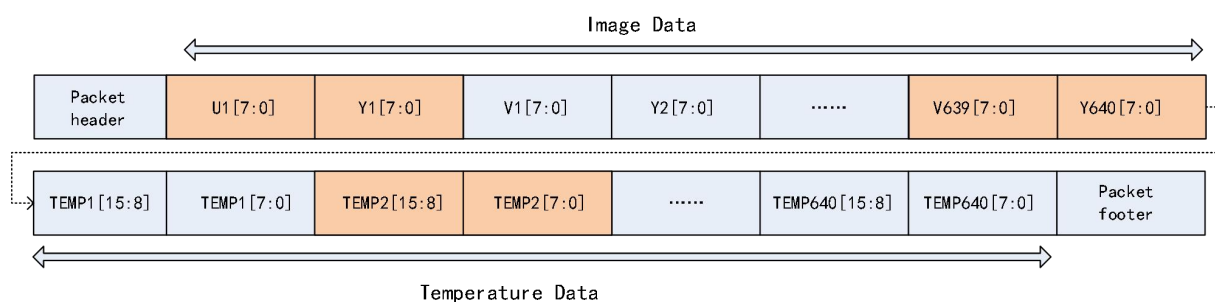


Figure 8 One Line of Valid Data

6. Dimension

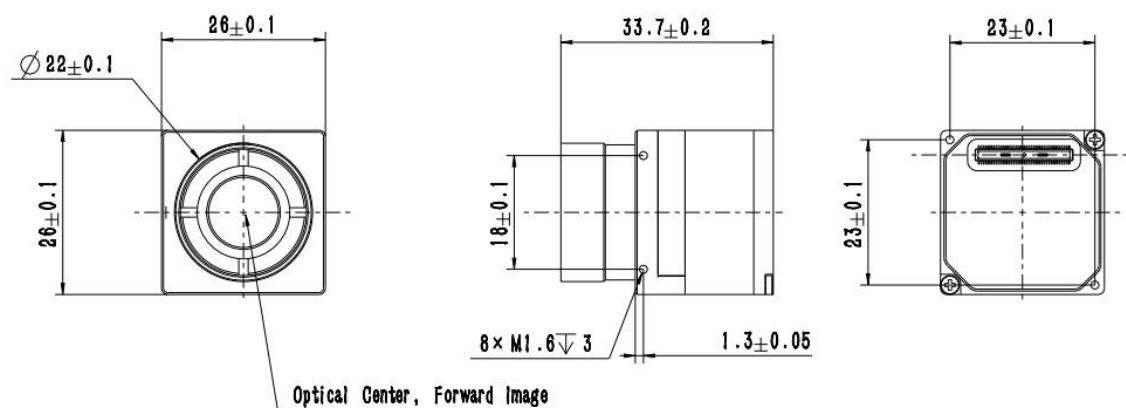


Figure 9 MicrollIS Module Dimension

The module dimension is different with different lens or user expansion board, please refer to the module structural drawings.

7. Announcements

To protect you and others from injury or to protect your equipment from damage, please read all the following information before using your equipment.

- (1) The product shall not face towards the sun or other high-intensity radiation sources directly;
- (2) The optimal environment temperature for operating is - 20 °C to 50 °C;
- (3) The detector window shall not be touched or hit with hands or other objects;
- (4) The equipment and cables shall not be touched with wet hands;
- (5) Please do not bend or damage cables;
- (6) Scrubbing your equipment with diluents is prohibited;
- (7) Do not unplug and plug cables when the power is on;
- (8) Wrong cable should not be connected in case that brings damages to the equipment;
- (9) Please pay attention to prevent static electricity;
- (10) Please do not disassemble the equipment. If there is any fault, please contact us, and professional personnel will carry out maintenance.

8. Supports and Services

8.1 Technical Supports

1. Modification design can be carried out according to different application requirements of users.
2. System training can be carried out for users' technical staff and operators.

8.2 After-sales Services

MicrolIIS is developed and manufactured by IRay. It has good after-sales service guarantees such as technical support and equipment maintenance. If you have any questions, please contact us.

9. Company Information

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